CONCEPT

Water Desalination: Reverse Osmosis and Thermal Plant Operation and Performance

18 – 29 July 2027
Riyadh - KAFD district five-star



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Introduction:

In water desalination, reverse osmosis racks and thermal evaporators lose output and money silently: silt density climbs after an algal bloom, membrane differential pressure creeps upward, cleaning slips and kWh per cubic metre rises before anyone connects the trends, while evaporators drift through scale and vacuum losses. This Core Concept course equips operators, engineers and chemists with the methods to manage seawater and brackish feed chemistry, intake screening, membrane racks, distillers, cleaning, remineralisation and brine discharge, and to judge productivity on normalised data. Participants finish by producing a Desalination Facility Output Review and Improvement Roadmap for their own site.

Course Objectives:

- Characterise seawater and brackish feed and calculate scaling tendency, osmotic pressure and salt balance for a desalination facility
- Run intake screening, DAF, dual media filters and ultrafiltration to hold silt density index and turbidity within membrane limits
- Operate reverse osmosis racks to target flux, recovery and salt rejection, including pressure exchangers, start-up and shutdown sequences
- Monitor multi-stage flash, multiple-effect distillation and vapour compression evaporators against brine temperature, gain output ratio and vacuum criteria
- Diagnose fouling and scaling, schedule clean-in-place, remineralisation and brine discharge measures, and trend normalised productivity and cost per cubic metre
- Compile a Desalination Facility Output Review and Improvement Roadmap with KPIs, root causes and prioritised actions

Target Audience:

- Shift operators and control room staff who run intakes, pretreatment and reverse osmosis racks day to day
- Process engineers responsible for facility output, recovery and kWh per cubic metre
- Chemists and laboratory analysts who test feed, permeate, distillate and product samples
- Maintenance supervisors responsible for high-pressure pumps, pressure exchangers, filters and dosing skids
- Instrument technicians who maintain analysers, transmitters, PLC loops and SCADA screens
- Evaporator operators who run multi-stage flash, multiple-effect distillation or vapour compression distillers

Course Outline:

Day 1: Desalination Foundations, Feed Chemistry and Facility Baseline

- Seawater and Brackish Feed Composition: Total Dissolved Solids, Major Ions and Temperature Range
- Membrane and Thermal Process Families: RO, Nanofiltration, Electrodialysis Reversal, MSF, MED and MVC
- Osmotic Pressure, Salt Rejection and Product Specification Targets
- Scaling Indices: Langelier Saturation Index, Stiff and Davis Index and Calcium Sulphate Saturation
- Facility Block Flow Diagram and Flow and Salt Balance Baseline

Day 2: Intake Structures and Pretreatment Sequences

- Open Seawater and Beach Well Intake Screening, Shock Chlorination and Marine Growth Prevention
- Coagulation With Ferric Chloride and Polymer Selection by Jar Testing
- DAF Operation During Algal Bloom and Oil Sheen Events
- Dual Media Pressure Filters: Filtration Rate, Backwash Sequence and Filter Ripening
- Ultrafiltration Pretreatment: Transmembrane Pressure, Chemically Enhanced Backwash and Integrity Testing

Day 3: Reverse Osmosis Design and Day-to-Day Running

- Spiral-Wound and Hollow Fibre Element Construction and Pressure Vessel Arrays
- Flux, Recovery and Concentration Factor Calculation for Stage and Pass Layout
- Silt Density Index Testing and Cartridge Filter Checks Ahead of the High-Pressure Pump
- Dechlorination With Sodium Bisulphite and Oxidation-Reduction Potential Monitoring
- Start-Up, Shutdown, Flushing and Permeate Backpressure Protection Sequences

Day 4: Pressure Exchangers, Instrumentation and Automation

- Isobaric Pressure Exchangers, Turbochargers and Pelton Wheels: Recovery Device Comparison
- High-Pressure Pump and Variable Speed Drive Operating Curves
- Conductivity, pH, ORP, Pressure and Flow Instruments Along the RO Rack
- SCADA and PLC Loops, Alarms and Interlocks for Membrane Protection
- Specific Power Consumption Calculation in kWh per Cubic Metre

Day 5: Week-One Integration: Seawater RO Rack Walkthrough

- Guided Walkthrough of Intake, Pretreatment and RO Rack Logsheets
- Feed Upset Case: Algal Bloom and Rising Silt Density Index
- Pressure Profile Reading Across First and Second Pass Arrays
- Chemical Dosing Log Audit: Coagulant, Antiscalant and Bisulphite Rates
- Week-One Findings Sheet and Operating Envelope Summary

Day 6: Thermal Desalination for Evaporator Operators

- Multi-Stage Flash Running: Top Brine Temperature, Brine Recirculation and Stage Levels
- Multiple-Effect Distillation Running: Effects, Thermal Vapour Compression and Low-Temperature Limits
- Mechanical Vapour Compression Distillers for Small and Remote Sites
- Gain Output Ratio and Performance Ratio Log Sheets
- Vacuum System, Non-Condensable Gas Venting and Demister Carryover Checks

Day 7: Scaling, Fouling, Clean-in-Place and Product Specification Assurance

- Fouling Diagnosis: Colloidal, Organic, Biofouling and Mineral Scale Signatures
- Antiscalant Selection and Dose Projection Software Runs
- Clean-in-Place Procedure: Low and High pH Solutions, Temperature and Recirculation Time
- Membrane Autopsy and Pressure Vessel Probing for Fault Location
- Boron and Bromide Removal and Product Specification Verification Schedule

Day 8: Remineralisation, Brine Discharge and Stakeholder Reporting

- Remineralisation With Limestone Contactors and Lime and Carbon Dioxide Dosing
- Product Stabilisation, Disinfection and Network Hand-Over Parameters
- Brine Outfall Diffuser Arrangement and Dilution Zone Monitoring
- Intake Impingement and Entrainment Mitigation for Marine Life
- Environmental Reporting and Communication With Utility, Grid and Community Stakeholders

Day 9: Normalisation, Maintenance, Power and Cost

- Normalised Permeate Flow, Normalised Salt Passage and Differential Pressure Trending
- Membrane Replacement Scheduling and Element Loading Strategy
- Condition-Based Maintenance for High-Pressure Pumps and Pressure Exchangers
- Cost per Cubic Metre Breakdown: Power, Chemicals, Membranes and Labour
- Troubleshooting Decision Tree: Low Permeate Flow, High Salt Passage and Rising Pressure Drop

Day 10: Capstone: Desalination Facility Output Review

- Facility Data Set Review of Logsheets and Laboratory Records
- KPI Dashboard Build: Recovery, Specific Power, Availability and Chemical Consumption
- Root Cause Analysis of Output Gaps Using Fishbone and Five Whys
- Improvement Action Register With Owners and Verification Measures
- Output Review Presentation and Peer Challenge

Skills You Will Gain:

- Feed Chemistry Assessment
- Pretreatment Sequence Management
- Membrane Rack Running
- Thermal Distiller Monitoring
- Fouling and Scale Diagnosis
- Clean-in-Place Scheduling
- Data Normalisation and Trending
- Desalination Cost Analysis

Why Attend This Course:

- Return with a Desalination Facility Output Review and Improvement Roadmap built from your own site data
- Spot silt density, differential pressure and salt passage trends early enough to clean before membranes are lost
- Cut kWh and chemical consumption per cubic metre by tuning recovery, pressure exchangers and dosing against measured results
- Compare practice with peers running seawater, brackish, membrane and thermal facilities across utilities and industry

Conclusion:

Reliable desalination output depends on understanding the feed and running every stage of the facility within clear limits. Week one builds operating capability from feed chemistry and pretreatment through reverse osmosis, pressure exchangers and automation, closing with a guided rack walkthrough. Week two adds thermal distillers, fouling and cleaning, remineralisation, brine discharge, normalisation, maintenance and cost. The final day turns this into a Desalination Facility Output Review and Improvement Roadmap that participants present and take back to their own site.